Preschoolers rely on visual cues in the interpretation of doubly quantified sentences: Evidence from eye tracking

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Background

English children interpret sentences containing a quantifier and negation in a linear/isomorphic manner, assigning wide scope to the initial operator (Musolino 2011). Explanation: the isomorphic reading is the default online interpretation of ambiguous sentences, the revision of which is costly cognitively.

We found in a series of experiments that Hungarian preschoolers show no tendency to interpret sentences with two numerical quantifiers isomorphically (É.Kiss, Gerős & Zétényi 2012; 2013). This is all the more surprising because scope interpretation in Hungarian adult language is isomorphic. Thus, whereas (1) only has the isomorphic/direct scope interpretation in (a) for adults, kids sometimes choose the direct (a), and sometimes the inverse (b) reading.

(2) Három fiú is két tornyot épít. three boy each two tower-ACC builds

(a) ‘Three boys each are building two towers.’

(b) ‘Two towers each are being built by three boys.’

The reaction time data show that children need more time to answer (apr. 700ms) than adults. This seems to corroborate the hypothesis that the task is computationally more costly for children.

In fact, the default reading of (2) for children, elicited in acting out tasks, is the collective reading in (3) (É. Kiss, Zétényi & Gerős 2012), i.e., kids don’t interpret ‘each’ as a distributive operator.

(3) ‘A group of three boys are building a group of two towers.’ (3 boys, 2 towers)

Hypothesis

If the default reading of a doubly quantified sentence for a child is the collective reading, then the distributive readings — both the direct and the inverse ones — require the revision of the collective interpretation. We tested if behavioral data corroborate the hypothesized revision.

Revision involves no linear order for the quantifiers; the preferred distributive reading is selected on the basis of visual cues. Chunked representations are preferred to condensed ones, and representations with 2 subevents are preferred to those with 3 subevents.

Methods

Subjects: 32 preschoolers (17 boys, 15 girls) mean age: 6.3 years

Control group: 23 adults (9 male, 13 female university students) ages 21-25 years.

Eye-tracking data show that the first phase of the session, before the presentation of the test sentence, there is no difference between adults’ and children’s eye movements.

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Musolino created 48 videos were created from the 24 test picture pairs and 24 filler picture pairs, with a voice-over of the test sentence.

Presentation: Stimuli were presented on a 17” notebook screen by Tobii Studio 3.1. Eye movements were simultaneously recorded by a Tobii X30-2 portable eye tracker, which was attached under the screen of the notebook.

The stimulus display contained 6 conditions: C1, C2, C3, C4, C5, C6

- Preference for direct scope is manifest/close to the adult level when the direct scope representation is chunked into subevents and the inverse representation is not (C5, C6).

- Pictures with 2 subevents (C1, C3, C5) are preferred to pictures with 3 subevents (C2, C4, C6) in both groups.

Results

Variables | Adults | Children
--- | --- | ---
Reaction time |  | 
Left AOI fixations during the first 3s | ≡ | 
Right AOI fixations during the first 3s | ≡ | 
Total AOI fixations until the answer |  | 
More AOI fixations on direct picture |  | 
Percentage of AOI fixations on direct picture |  | 
Total duration of AOI fixations |  | 
More AOI visit duration on direct picture |  | 
Percentage of AOI visit duration on direct picture | arrows: significant (min p<0.05), directions: larger values

The reaction time data show that children need more time to answer (apr. 700ms) than adults. This seems to corroborate the hypothesis that the task is computationally more costly for children.

The longer duration of visits may reflect the difficulty of resolving the conflict that children experience between the default collective interpretation of the sentence and its distributive readings shown in the pictures.

Summary

- Preschoolers ignore the linguistic cue (the particle is ‘each’) that forces adults to interpret distributive scope online; their default reading of doubly quantified sentences is the collective one.

- When stimuli force children to access a distributive reading, their interpretation data display longer reaction times, less fixations and longer durations.

- Behavioral data reveal that children ‘try harder’, presumably first computing the default collective reading, and then revising it.

- Of the two distributive readings, they eventually choose the one that is easier to process visually — i.e., they also exploit non-linguistic, visual information.

References


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